

Determining the Ideal Lockdown Location

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1. Introduction

1.1 Background

A novel coronavirus, later named Covid-19, was first identified in Wuhan, Hubei Province in December 2019. Highly contagious, within a matter of weeks it had spread around the world and was named a pandemic by the World Health Organisation (WHO) on March 11th, 2020.¹

The first case in Ireland was reported in February 2020² and now, over a year on, the country is still grappling with how to manage the outbreak. Residents of Ireland have been placed into Level 5 of the Living with Covid Plan³ three times, totalling over seven months to date. Level 5 mandates that many amenities must close, such as gyms, restaurants, pubs, shops, and other non-essential businesses. It also includes a restriction that residents may not travel beyond a radius of 5km from their homes.⁴

As a result of this lockdown, many people have been relying on and exploring their local neighborhood much more than they would have before the pandemic hit. Where before they may have travelled further afield to work, shop, or exercise, they have been required to do all of these things in close proximity to their homes. Indeed, with many people working from home, the allure of living closer to the city to allow for a short commute is no longer in play, and the high cost of rent in the city is no longer offset, leading many to consider moving out of the city when their lease is up.

1.2 Problem

There are many factors that typically contribute to the ideal place to live such as commute time to work, public transport options, proximity to amenities or nightlife, that are simply no longer applicable during a pandemic. Rather, factors such as the number of supermarkets and parks nearby or the spread of Covid-19 in the community take on a much more significant role. Other factors, such as the cost of rent, are a constant, though its impact on desirability may fluctuate. This project aims to assess how the desirability of neighborhoods in Dublin has changed as a result of the Covid-19 pandemic.

1.3 Interest

This project would primarily be of interest to those looking to relocate while the pandemic is still at its height, when the traditional factors of where to live are no longer at play. Many people living in the city centre with leases coming to an end may consider moving to an area with cheaper rent and more outdoor spaces, for example. Additionally, those who have found themselves working from home for the past year and who expect to be doing so for some time into the future may also prefer to not have to pay the cost of city living.

¹ <https://www.who.int/news/item/29-06-2020-covidtimeline>

² <https://www.rte.ie/news/2020/0320/1124382-covid-19-ireland-timeline/>

³ https://www.citizensinformation.ie/en/covid19/living_with_covid19_plan.html

⁴ <https://www.gov.ie/en/publication/2dc71-level-5/>

2. Data acquisition and cleaning

2.1 Data sources

Based on the definition of our problem, factors that may impact our decision are:

- The number of amenities within a 5km radius
- The number of amenities within a 5km radius that are open during Level 5 lockdown
- The average rent in the area
- The latest 14-Day Incidence Rate in the area

It was decided to use a regularly spaced grid of centroids across Dublin to define our neighborhoods.

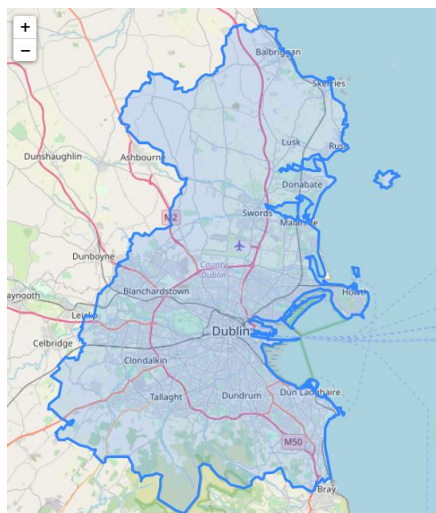
As such, data will be fetched or extracted from the following data sources:

- Amenities in each neighborhood will be obtained using the Foursquare API.⁵
- Average monthly rent will be obtained from Ireland's Central Statistics Office.⁶
- Dublin shapefile is obtained from data.gov.ie⁷, Ireland's open data portal
- Dublin Local Electoral Areas and 14-Day Covid-19 incidence rate per 100,000 is sourced from Covid-19 GeoHive⁸, Ireland's Covid-19 Hub
- Centers of the neighborhoods will be generated algorithmically and approximate addresses of centers of those areas will be obtained using Nominatim⁹
- Coordinate of Dublin center will be obtained using Nominatim¹⁰

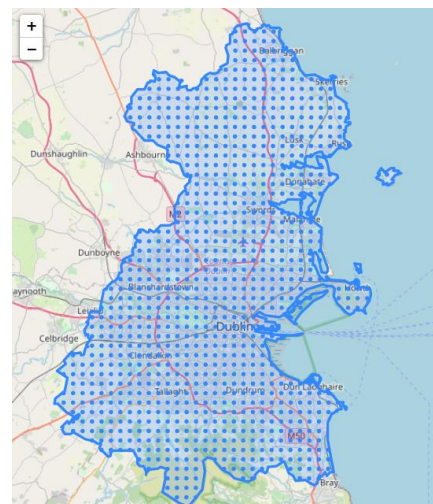
2.2 Data cleaning

The goal of this process was to obtain a table containing one row per neighborhood with all relevant information to determine its score.

The shapefile obtained from data.gov.ie for the Dublin boundary contained the boundary for every county in Ireland and so was stripped to only give the boundary needed.



Dublin Shapefile



Neighborhoods

⁵ <https://developer.foursquare.com/>

⁶ <https://data.cso.ie/>

⁷ <https://data.gov.ie/dataset/counties-osi-national-statutory-boundaries1>

⁸ https://covid-19.geohive.ie/datasets/27d401c9ae084097bb1f3a69b69462a1_0

⁹ <https://nominatim.org/>

¹⁰ <https://nominatim.org/>

The neighborhoods were determined by starting at one corner of the boundary of the shapefile, incrementing by 1km and checking if that point was in the shapefile.

The average rent data was provided on a per-town basis, with the amount in Euros. As such, it was not directly applicable to our neighborhoods. To handle this, the coordinates for each town in the rent data were retrieved using Nominatim. Then each neighborhood was mapped to its nearest town using the Euclidean distance.

The total number of Covid-19 cases per area is not currently available due to data protection reasons, but we do have access to the 14-Day Incidence Rate. This data is provided per Local Electoral Area (LEA) and is given in cases per 100,000 people. It was convenient that the data was already provided in a rate so that we didn't have to take the population of each neighborhood into account. Instead, we could simply check which LEA the neighborhood was in and take that incidence rate. It is worth noting that we are only given the data for the past 14 days, however, and that the quality of the output of the project could be improved by more comprehensive data when it is available.

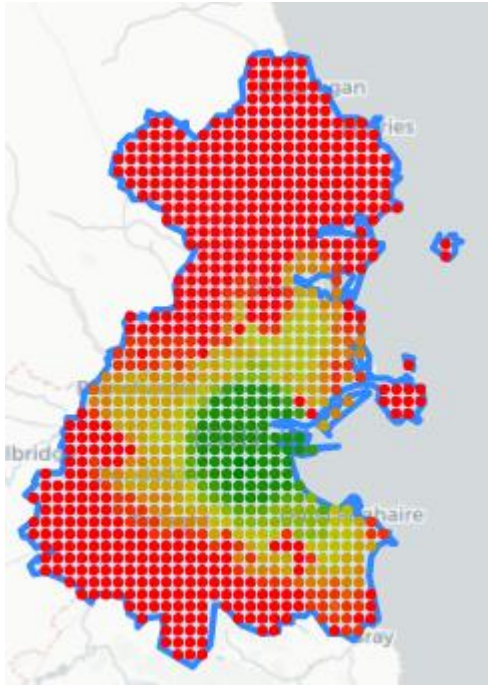
The comprehensive list of categories used by FourSquare is retrievable via their API, and once it was attained it was manually annotated to indicate whether that category contributes to quality of life (residences, for example, do not) and whether or not it was open during a Level 5 lockdown. This data was then loaded back into the notebook.

Next the nearby venues were retrieved for each neighbourhood. The approach was tested with one neighborhood – Clonsilla. At first this was done by simply sending one query, but it was quickly observed that any neighborhood with more than 100 venues was suffering because of the 100 result limit from the API. That is, the API was returning popular venues such as cinemas and concert venues ahead of the likes of small supermarkets, so the lockdown data was skewed to favour towns with fewer amenities which were therefore better represented in 100 results. In the case of Clonsilla, it had 337 amenities. The solution to this was to check if the initial request indicated there were more than 100 results for the area, in which case a series of subsequent requests were sent, one for each of the major categories according to the API. This yielded much more favourable results.

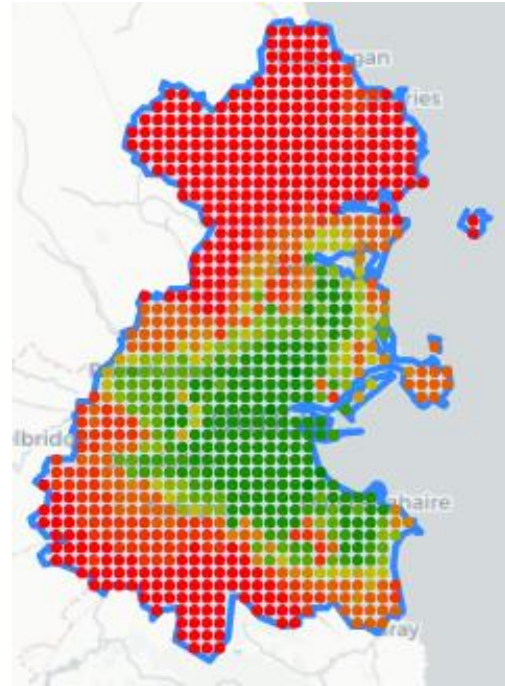
The raw venue results per neighborhood were then joined with the annotated categories to determine which contributed to quality of life and whether they were open during lockdown. This was then aggregated to get one row per neighborhood, which could then be easily joined with the rental cost and Covid-19 data.

3. Methodology

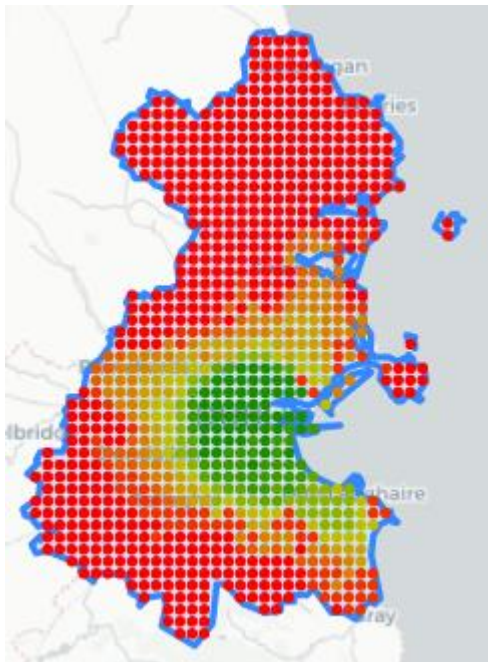
It was decided to use a weighted sum of the factors impacting neighborhood desirability to determine the ideal place in which to live both before the pandemic struck and during the strictest lockdown.



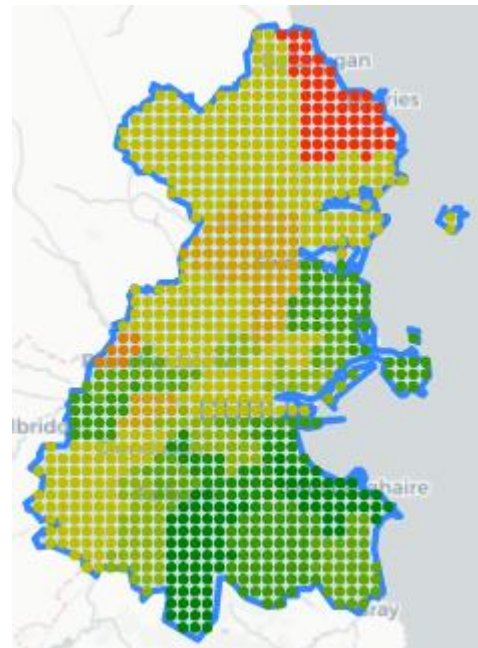
Quality of Life



Food Delivery Options

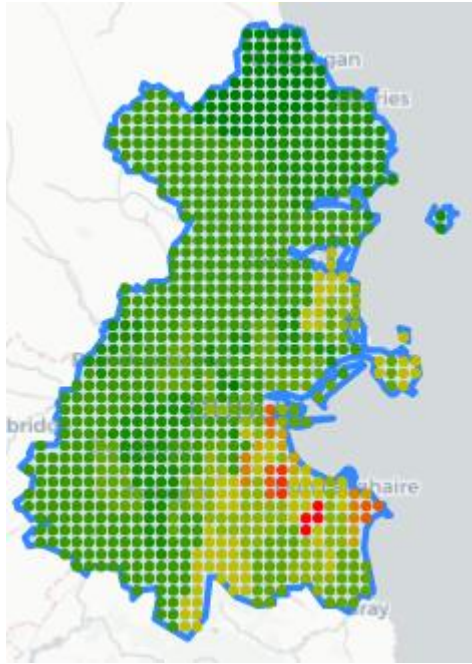


Open Amenities during Lockdown

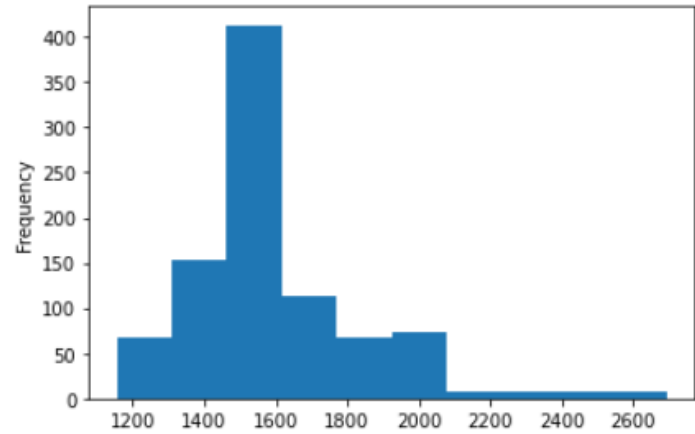


Covid-19 Incidence Rate

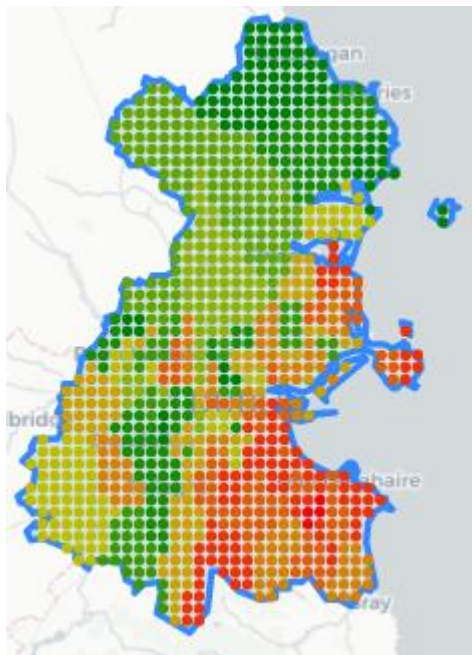
In order to do this, the factors needed to be scaled so that they could be appropriately combined. The simplest method for this was to scale based on the min and max of each attribute so that the resulting value was between 0 and 1. This approach was applied to the Quality of Life, Open, Average Rent, Delivery, and Covid Cases columns. It seemed appropriate for all but the average rent which was right skewed and so the majority of the data would have very similar scores. To combat this, a quantile transformation was used to transform the data to a normal distribution which would give fairer scores.



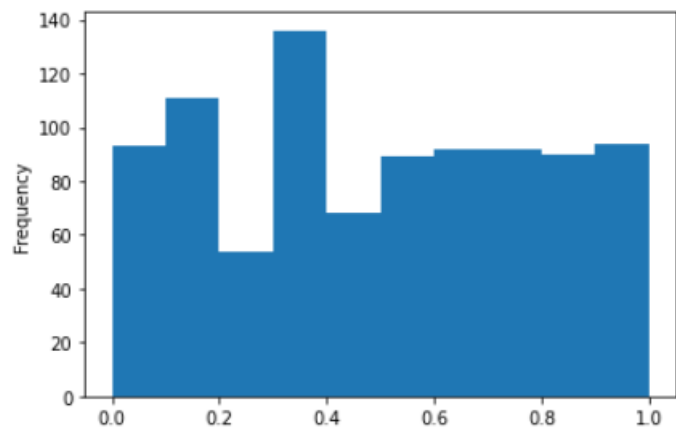
Average Rent in Euro



Average Rent histogram



Normalised Average Rent



Normalised Average Rent histogram

Next, a weighted sum was applied to get the score for each neighborhood before the pandemic hit, during lockdown, and during lockdown taking into account food delivery from restaurants.

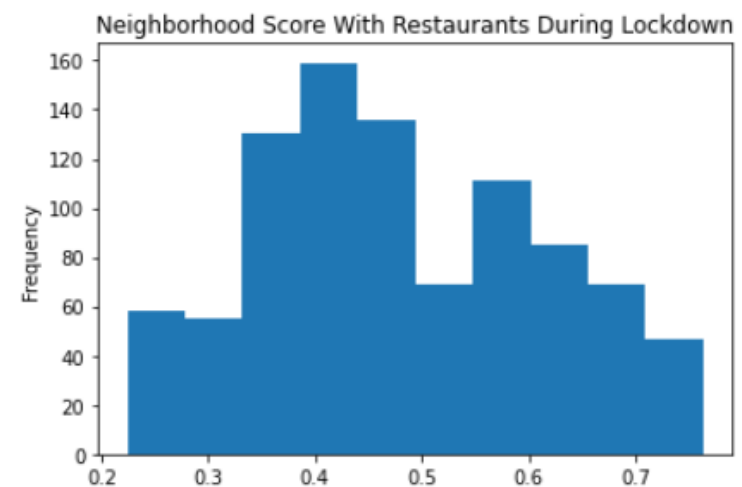
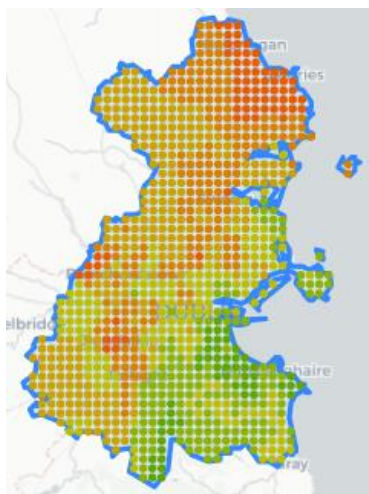
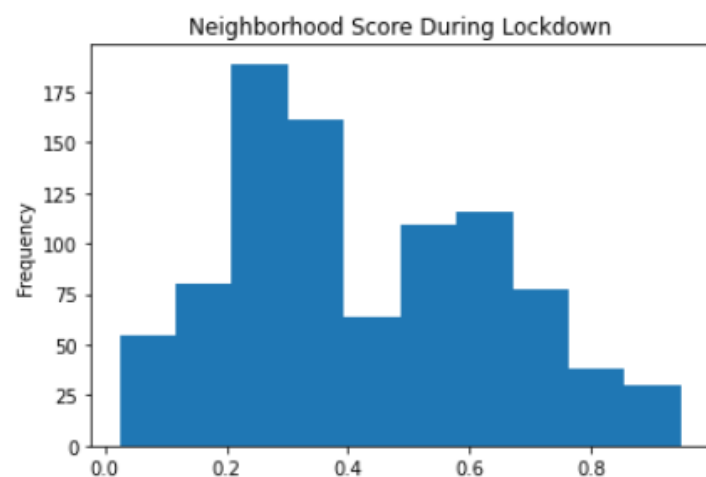
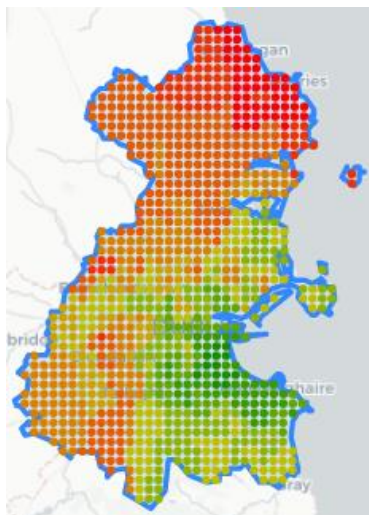
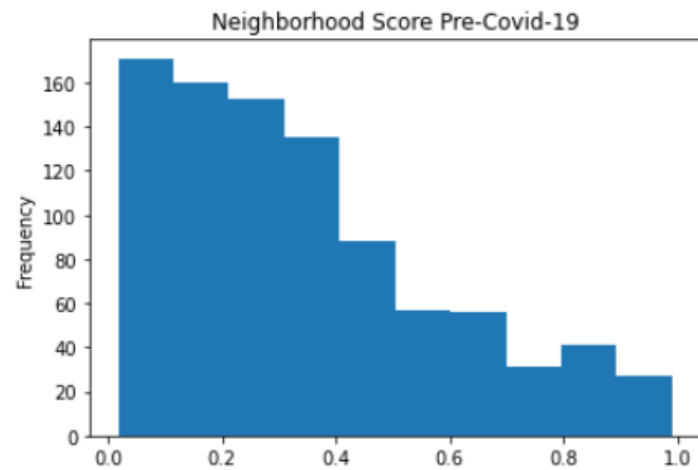
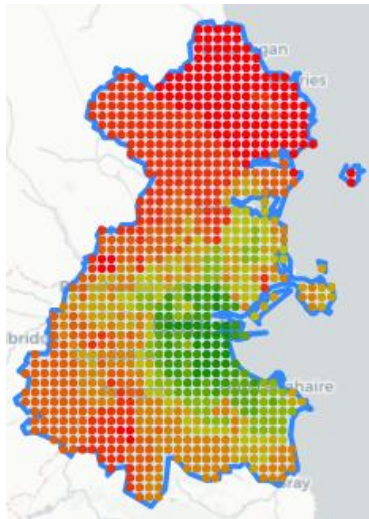
$$\text{Score PreCovid} = \text{QualityOfLife} \times 0.6 + \text{AvgRent} \times 0.4$$

$$\text{Lockdown Score} = \text{OpenAmenities} \times 0.3 + (1 - \text{CovidRate}) \times 0.3 + \text{AverageRent} \times 0.4$$

$$\text{Lockdown Score with Restaurants} = \text{OpenAmenities} \times 0.25 + (1 - \text{CovidRate}) \times 0.25 + \text{RestaurantsForDelivery} \times 0.2 + \text{AverageRent} \times 0.3$$

4. Results

The product of the above data wrangling and analysis was three scores for each neighbourhood: before the pandemic hit, during lockdown, and during lockdown taking into account food delivery from restaurants. The results are as follows:



It would appear from the maps that South Dublin is the most desirable area both before and during the pandemic. While this may be true, we can conclude from both the map and the subsequent histograms that the spread of desirability is much broader during a Level 5 Lockdown. As anecdotally observed, the city centre is no longer the hub that it once was and the greater Dublin area proved more able to compete for residents.

5. Discussion

After applying a simple scoring function of a weighted sum of the properties of the neighborhoods, it was observed that the spread of desirability is significantly wider during a Level 5 Lockdown, when the suburbs can more easily compete with the city centre. This is in keeping with the anecdotal evidence that inspired this project and may be an indicator of a less densely populated city centre in a post-pandemic Dublin.

Indeed, it has been noted (again anecdotally) that many people originally from outside of Dublin are moving out of the city entirely to return their home counties across Ireland. Here, rent is even cheaper and they may have family already rooted in the community. Future census information will hopefully yield data that will allow further investigation into the long term effects of the pandemic and a culture of working from home.

It is worth noting that the scoring system used for this project is subjective, and will vary depending on a person's tastes. This is indicated by the lockdown score with and without taking restaurant delivery into account, which may or may not be applicable to a person. As such, a next step for this project could be to determine a person's tastes, perhaps from a quiz, and use that information to give them a more personalised result.

6. Conclusion

The purpose of this project was to determine the optimal location in which to live in Dublin, taking into account the amenities available within a 5km radius, the average rent, and the latest Covid-19 incidence rate, specifically, during the Covid-19 pandemic.

I generated a 1km spaced grid of neighborhoods across Dublin, then for each neighbourhood acquired the nearby venues, average cost of renting, and 14-Day Covid-19 Incidence Rate.

After applying a simple scoring function to the neighborhoods, it was observed that the spread of desirability is significantly wider during Lockdown, when the suburbs can more easily compete with the city centre. This is also supported by the fact that the most desirable neighborhood during lockdown (Roebuck) was further out from the city than that from before the pandemic (North Dock).